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A LONGITUDINAL ANALYSIS OF INJURIES RESULTING IN
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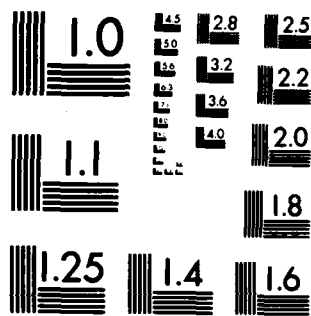
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A Longitudinal Analysis of Injuries Resulting in Physical Disability¹

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SUMMARY

Problem

Navy personnel who have diseases or injuries which may interfere with their ability to perform their duties may be referred to a Physical Evaluation Board (PEB) to determine whether they should be separated from the service. The Accidents, Poisoning and Violence (APV) diagnostic category accounted for 19.1% of all disability separations in 1974. Existing Navy statistics on PEBs and previous analyses of causes and consequences of accidental injuries have not related PEB separations to the original injuries which caused them.

Objective

The objective of the study was to provide a more precise analysis of PEB separations by analyzing the consequences of accidental injuries in terms of PEB dispositions. By relating type of injury and body part affected to degree of disability awarded and length of time between the injury and the PEB, information on the relative costs of various types of injuries can be obtained.

Approach

The study included all Navy enlisted personnel who were hospitalized during 1974 with a primary diagnosis in the APV category with a PEB hearing within six years of that hospitalization. For each of these individuals, PEB actions were related to initial hospitalization. The distribution of dispositions relating to retirement, discharge and return to duty was analyzed for the 705 PEB cases included in the study. In addition, the frequency and probability of disability separation, severity of disability, and time between injury and PEB was analyzed as a function of the type of injury and body part, separately and in combination.

Results

Although more than 90% of injuries that convened a PEB resulted in separations from the service, only 9.5% of all injury hospitalizations convened a PEB. The fracture was the type of injury resulting in the great majority (44.4%) of disability separations. More than half the disability separations involved fractures, dislocations, and sprains/strains to the extremities, especially the lower limbs. The types of injuries resulting in the greatest number of disability separations were generally awarded the lowest disability ratings. The least serious injuries, based on disability percentage, required the longest time to separate. Although hospital admissions for nerve and spinal column injuries were infrequent, they had the highest probabilities of disability separation. The average time between injury and disability separation was 12.6 months. The more serious injuries, such as head injuries, fractures of the trunk, abdominal injuries, and amputations required considerably less average time to separation (approximately 5-10 months). The least serious injuries were musculoskeletal (fractures, dislocations, and sprains/strains to the extremities and back strains). These injuries generally required 14-15 months to separate.

Conclusions/Recommendations

The finding that more than half the disability separations involved musculo-skeletal injuries to the extremities reflects the importance of mobility in PEB fitness-for-duty decisions. Since hospitalization and time awaiting PEB disposition are usually unproductive times, decision making guidelines for PEBs should be clarified and refined to expedite this process, especially for musculo-skeletal injuries.

A Longitudinal Analysis of Injuries Resulting in Physical Disability¹

INTRODUCTION

Diseases or injuries of U.S. Navy personnel may result in separation from the service due to physical disability. Such separations represent an unplanned loss to the naval service that may affect fleet readiness. These separations are costly in the short term because of large expenditures for severance pay and the need to train replacements. In the long term, disability compensation may extend over many years.

Naval personnel who have physical defects which may interfere with their ability to perform their assigned duties may be referred to a Navy Physical Evaluation Board (PEB). The PEB considers various medical and administrative reports to determine physical qualifications relative to retention on active duty, disability retirement, or discharge from the service. In addition, the PEB determines the degree of disability and whether the disability is temporary or permanent. The Board also decides whether the disability was incurred while on active duty or existed prior to enlistment and whether the disability was due to intentional misconduct or willful neglect or occurred during a period of unauthorized absence from duty.

The presence of a physical disability does not require a finding of unfitness for duty but is dependent on the nature and degree of functional impairment as well as the physical ability of the member to perform the requirements of assigned duties by virtue of his/her office, rank, grade, or rating (occupation). Special hazardous duty, such as flying or diving, may be excluded from consideration, but the requirements of many other potential sea or combat assignments may be considered [U.S. Navy Disability Evaluation Manual, 1980]. Thus, a physical disability may not disqualify a member from a particular occupation, but the demands of certain work settings, such as a destroyer-type ship, might disqualify an individual from performing other important naval duties in that environment.

The health status of active duty Navy and Marine Corps personnel is reported annually in Medical Statistics, U.S. Navy which includes hospital admissions, deaths, and PEB separations analyzed by principal cause. This cross-sectional analysis of PEB separations, however, is limited to the year being reported and cannot be directly related to the illness or injury which causes the separation, since separations often do not occur in the same calendar year as the initial illness/injury. It is not unusual for more than a year to pass between initial illness/injury and separation due to factors such as length of hospitalization, administrative processing, delayed recognition of the disability, or the development of complications.

During 1974 the Accidents, Poisonings, and Violence (APV) diagnostic category was the leading cause of hospitalization for naval personnel and accounted for 19.1% of all disability separations [Military Statistics, U.S. Navy, 1973/1974]. Previous analyses of causes and consequences of accidental injury to naval personnel have not linked PEB separations to the original injuries which caused them [Ferguson, McNally and Booth, 1981]. In this study a more precise analysis of PEB separations was possible because original injuries could be identified and the data could be analyzed longitudinally to determine long-term consequences. Such an approach requires the capability to efficiently process very large volumes of data and to devise specialized programming techniques for ordering diverse data elements chronologically.

The purpose of the study then was to examine the consequences of accidental injuries in terms of PEB disposition. In addition, some information was obtained on the relative costs of various types of injuries by relating type of injury and body part affected to degree of disability awarded and length of time between the injury and the PEB. The results may provide insights into how the PEB decision process can be made more efficient and costs of accidental injury reduced.

METHOD

The study included all Navy enlisted personnel who met two criteria: (1) hospitalization in a Navy medical facility during 1974 with a primary diagnosis in the Accidents, Poisonings, and Violence (APV) category of the International Classification of Disease, Adapted for Use in the United States, Eighth Revision, and (2) a PEB hearing within six years of that hospitalization. To insure that the PEB actions were related to initial hospitalizations, hospitalization and PEB diagnoses were compared. Only those cases were included which met the following criteria: (1) identical hospitalization and PEB diagnoses; (2) different diagnoses but the APV diagnosis was logically related to the PEB diagnosis and involved the same body part; or (3) the PEB diagnosis was not in the same APV category but was the logical result of an injury involving the same body part. If more than one APV hospitalization occurred during 1974, only the first admission was considered. Readmissions from an earlier year were excluded. The method for comparing PEB and injury diagnoses was reviewed by two experienced medical officers.

Hospitalization and PEB records were obtained from computer files maintained at the Navy Medical Data Services Center, Bethesda, Maryland. These records were edited and incorporated into the medical history files for all active duty personnel maintained at the Naval Health Research Center, San Diego.

The distribution of dispositions relating to retirement, discharge, and return to duty was analyzed for the 705 PEB cases included in the study. In addition, the probability of disability separation, severity of disability, and time between injury and PEB were analyzed as a function of the type of injury and body part, separately and in combination. Severity of disability was measured by the disability rating awarded by the PEB. This rating is represented as a percentage, ranging from 10 to 100%. The probability of separation for a given condition was determined by dividing the number of disability separations for that condition by the number of APV admissions for the same condition occurring in 1974.

RESULTS

A comparison of hospitalization and PEB records revealed that of 7,400 admissions with APV diagnoses during 1974, 705 (9.5%) were referred to PEBs within six years following admission. The actions taken by the PEBs on these cases are shown in Table 1. This table indicates that separation from the Navy was the action most frequently taken by the board. More than 90% of these cases were found to be physically unfit to perform their naval duties.

Table 1
Distribution of Physical Evaluation Board Dispositions
Related to 1974 Injury Hospitalizations

<u>Disposition</u>	<u>Number of Cases</u>	<u>Percent</u>
Severance Pay	406	57.6
Disability Retirement	209	29.7
Discharge without Benefits	20	2.8
Fit for Full/Limited Duty	67	9.5
Died (awaiting disposition)	3	.4
Total	705	100.0

In 213 of the 705 cases (30.2%), the PEB diagnosis was not in the APV category, yet the PEB action appeared to be clearly the result of the earlier injury. Musculoskeletal and connective tissue disorders accounted for 91.1% of these non-APV PEB diagnoses with joints the most frequently mentioned anatomical site. The frequency distribution and description of these non-APV diagnoses are presented in Table 2.

Table 2
Distribution of Non-APV Physical Evaluation Board Diagnoses

<u>Category and/or Diagnosis</u>	<u>Number of Cases</u>
Diseases of the Musculoskeletal System and Connective Tissue	194
Other Diseases of Joint	60
Internal Derangement of Joint	36
Other Deformities	18
Osteoarthritis - Allied Condition	14
Arthritis, Other Specified	13
Vertebrogenic Pain Syndrome	13
Displacement of Intervertebral Disc	12
Ankylosis of Joint	12
Affection of Sacroiliac Joint	4
Curvature of Spine	3
Arthritis, Unspecified	3
Synovitis/Bursitis/Tenosynovitis	2
Other Disease of Bone	2
Osteomyelitis and Periostitis	2
Diseases of the Nervous System and Sense Organs	9
Symptoms and Ill-defined Conditions	8
Mental Disorders	2
Total	213

The distribution of disability separations by type of injury and body part affected is shown in Table 3, as well as the proportion of noninjury diagnoses for each type of injury and body part. Fractures, dislocations, and sprains/strains accounted for almost three-fourths (73.7%) of the separations, with lower limb injuries accounting for 63.4% of these injury types. More than half (52.4%) of all separations involved lower limbs, with upper limbs contributing an additional 16.3%. When injury type and body part were analyzed in combination, the majority (53.9%) of separations were found to be caused by fractures, dislocations, and sprains/strains to the extremities. Non-injury, residual condition diagnoses comprised 30.6% of the total, with the majority (62.6%) occurring in the dislocation and sprain/strain injury types and to the lower limbs and back (77.4%).

Table 3

Percentage Distribution for Disability Separations by Type of Injury and Body Part

Type of Injury	N	Percent of Total							All	Non-APV PEB Diagnosis (%)
		Head Face	Spinal Column	Back	Trunk Abdomen	Upper Limbs	Lower Limbs	Mult. Other		
Fractures	283	2.0	9.7		.6	4.7	27.1	.2	44.4	16.7
Dislocations	97					2.5	12.7		15.2	67.0
Sprain/strain	90			7.1			6.9	.2	14.1	63.3
Intracranial	36	5.6							5.6	16.7
Internal	3				.5				.5	0.0
Open Wounds	49	1.6			.2	3.8	1.9	.3	7.7	30.6
Amputations	34					2.2	3.1		5.3	5.9
Nerve	33	.5	.5			3.1	.6	.5	5.2	6.3
Other	13							2.0	2.0	7.7
Total	638	62	65	45	8	104	334	20		
Percent		9.7	10.2	7.1	1.3	16.3	52.4	3.2		
Non-APV PEB Diagnosis Percent	30.6	17.7	10.8	34.4	0.0	22.1	35.9	15.0		

The average number of months between hospitalization and disability separation by type of injury and body part is shown in Table 4. Standard deviations are shown in parenthesis. The average time interval is 12.6 months for all types of injuries with a standard deviation of 8.3 months. By type of injury, this table shows that sprains/strains and dislocations took the longest times before separation, while internal injuries, other types of injuries not listed, and intracranial injuries took the shortest times. Disability separation decisions were made most quickly for head/face and abdominal injuries and most slowly for back and lower limb injuries. Analysis of injury type and body part combinations revealed that fractures and internal injuries to the abdomen/trunk, amputations to the extremities, and nerve injuries to the lower limbs were most quickly separated. Injuries requiring the longest time between admission and separation were musculoskeletal injuries to the back and extremities, and nerve injuries to the spinal column.

Table 4

Average Time (In Months) between Injury and Disability Separation by Type of Injury and Body Part

Type of Injury	Body Part						Mult. Other	Total
	Head Face	Spinal Column	Back	Trunk Abdomen	Upper Limbs	Lower Limbs		
Fractures	10.1 (5.5) ^a	11.3 (7.6)		5.6 (1.7)	12.0 (6.4)	14.0 (7.8)		12.8 (7.6)
Dislocations					14.4 (8.3)	13.7 (8.7)		13.8 (8.6)
Sprain/strain			15.4 (11.6)			15.7 (11.0)		15.4 (11.2)
Intracranial	8.7 (4.6)							8.7 (4.6)
Internal				8.0 (4.8)				8.0 (4.8)
Open Wounds	8.9 (7.1)				11.8 (5.7)	10.7 (4.1)		10.9 (5.7)
Amputations					8.5 (3.9)	9.6 (9.6)		9.2 (7.7)
Nerve	11.3 (11.1)	15.2 (11.4)			12.3 (7.1)	5.6 (2.4)	11.7 (5.8)	11.6 (7.6)
Other							8.1 (9.4)	8.1 (9.4)
Total	9.2 (5.5)	11.5 (7.7)	15.4 (11.6)	7.8 (4.6)	12.0 (6.5)	13.7 (8.6)	8.1 (8.1)	12.6 (8.3)

^aStandard deviation.

The average percent of disability rating by type of injury and body part is presented in Table 5. Internal injuries, intracranial injuries, and amputations received the highest disability ratings, while dislocations and sprains/strains received the lowest ratings. With respect to body part, injuries to the head/face and spinal column received the highest ratings and injuries to the lower limbs received the lowest ratings.

The probability of being separated for disability due to injury is presented in Table 6 for each type of injury and body part. These proportions were determined by dividing the frequency of disability separations by the frequency of initial hospital admissions. Although amputations and nerve injuries had the highest separation rates and together accounted for 10.5% of all disability separations, these injuries comprised only 2.4% of all hospital admissions. Fractures to the spinal column and fractures, dislocations, and sprains/strains of the lower limbs involved relatively high risks of later disability separation and represented high frequencies of hospital admissions as well. Although injuries to the head and face ranked second in number of hospital admissions and accounted for a substantial proportion (22.7%) of all admissions, the probability of separation was relatively low (3.7%).

Table 5
Mean Disability Ratings by Type of Injury and Body Part

Type of Injury	Body Part							Total
	Face	Spinal Column	Back	Trunk Abdomen	Upper Limbs	Lower Limbs	Mult. Other	
Fractures	63.9	38.2		32.5	21.3	20.6		26.6
Dislocations					14.7	14.9		14.9
Sprain/strain			14.2			17.6		15.8
Intracranial	49.4							49.4
Internal				70.0				70.0
Open Wounds	36.0				22.7	20.0		26.4
Amputations					33.9	39.4		37.1
Nerve	36.7	55.0			30.5	26.7	30.0	32.3
Other							30.8	30.8
Total	49.7	38.8	14.2	28.0	24.6	19.9	39.0	25.2

Table 6
Probability of Disability Separation by Type of Injury and Body Part^a

Injury Type	Number of Hospital Admissions	Body Part							Total
		Face	Spinal Column	Back	Trunk Abdomen	Upper Limbs	Lower Limbs	Mult. Other	
Fractures	2412	.025	.302		.026	.059	.177	.040	.117
Dislocations	723					.085	.151		.134
Sprain/strain	1071			.073			.116	.014	.084
Intracranial	944	.038							.038
Internal	170				.018				.018
Open Wounds	950	.050			.019	.068	.054	.032	.052
Amputations	100					.189	.769		.340
Nerve	76	.333	.154			.455	.667	.750	.434
Other	954							.014	.014
Total	7400	.037	.298	.073	.021	.089	.155	.017	.095
Number of Hospital Admissions		1681	218	620	380	1172	2149	1180	7400

^aProportions of injured personnel who were separated within six years of injury.

DISCUSSION

This study has shown that during 1974 the majority (90.5%) of injuries referred to a PEB resulted in some type of separation from the service, often with disability compensation. However, PEBs were convened for only a small proportion (9.5%) of injury hospitalizations during that year.

Relating PEB diagnosis to the associated injury through a longitudinal analysis resulted in a more precise accounting of PEB dispositions and allowed for additional analyses which would not be possible using cross-sectional methods. A substantial proportion (30%) of PEB diagnoses did not receive an accidental injury (APV) diagnosis classification but represented residual conditions or

complications of the original injury. To establish that these PEB noninjury diagnoses were associated with earlier injuries, hospitalization and PEB records were chronologically ordered for each individual and shown to be logically related.

Both type of injury and body part were determinants of probability of separation and disability ratings, particularly in combination. The probability of separation for fractures was generally low, but the probability for spinal column fractures was more than twice that for total fractures. Similarly, fractures of the head and spinal column received mean disability ratings of 63.9% and 38.2%, respectively, compared to a mean disability rating of 26.6% for all fractures.

Although hospital admission rates and disability ratings for head and face injuries were relatively high, the percentage of admissions resulting in later disability was quite low, possibly reflecting policies requiring admission for observation as a precautionary measure.

The fact that the musculoskeletal system accounted for almost three-fourths of the disability separations stresses the importance of the mobility factor in PEB disability decisions. More than half the separations involved fractures, dislocations, and sprains/strains to the extremities. Although these types of injuries resulted in a high frequency of separations, relatively low disability ratings were awarded these injury types (a mean of 17.8% compared to an overall rating of 25.2%). In fact, the more frequent the separation for a type of injury, the lower the disability rating (Spearman rho = $-.77$, $p \leq .05$). As might be expected, this inverse relationship also was found between disability rating and time interval between initial hospitalization and separation. The more serious injuries with high disability ratings (internal and intracranial injuries and amputations) required the shortest times to separate, whereas the least serious injury types took the longest times (Spearman rho = $-.82$, $p \leq .01$). Fractures and dislocations to the lower limbs serious enough to require separation required the longest hospitalization time which added to the time to separation. A previous study by the authors [1981] found that fractures and dislocations resulted in the longest average hospital stay. Also, in the current study it was found that such injuries had the highest proportion of residuals and complications which would also increase the time to separation.

The average length of time between hospitalization and the PEB separation decision was slightly more than one year, with a range of 5 to 16 months, depending on the type of injury and body part. Although disability compensation and the required replacement training funds are obvious costs of serious injuries, the length of time from hospitalization to final separation from the service is a less visible but important cost as well. This is predominantly an unproductive period, when the individual is hospitalized, undergoing therapy, or, at best, performing limited duty assignments, often unrelated to his occupation. To the extent that a portion of this period involves the decision-making process by the PEB, better final disposition decision-making criteria may be needed to expedite this process. This is especially true for fractures, dislocations, and sprains/strains which accounted for the majority of PEBs and almost three-fourths of the disability separations. Even though these injuries involved a lesser degree of physical disability, they still required the longest time between hospital admission and separation from the service. Thus, the Navy, and the Medical Department particularly, would benefit most by refining the disposition decision-making process for these types of injuries.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) U.S. Navy enlisted personnel hospitalized with primary diagnoses under the Accidents, Poisoning, and Violence (APV) category were followed to determine Physical Evaluation Board (PEB) decisions within six years of initial injury. The probability of disability separation, the severity of disability, and the time between injury and PEB were analyzed as functions of the type of injury and body part. Only 9.5% of APV hospitalizations resulted in a PEB, but 90% of the PEBs resulted in service separations.		

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More than half of the disability separations involved fractures, dislocations, and sprains/strains to the extremities, especially the lower limbs. Nerve and spinal column injuries, although infrequent, had the highest probability of disability separation. The average time between injury and disability separation was 12.6 months with the more serious injuries (head, abdominal, and amputations) requiring the least average time (5-10 months) and the less serious injuries (fractures, dislocations, and sprains/strains) requiring the longest time (14-15 months). The PEB decisions showed that mobility was an important factor in fitness-for-duty decisions. It was recommended that decisionmaking guidelines, especially for less serious injuries, be improved to reduce the time between hospitalization and PEB disposition,

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